Epidemiological and clinical patterns of diabetes mellitus in Benghazi, Libyan Arab Jamahiriya

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الأنماط الوبائية والسريرية للسكّري في بنغازي بالجماهيرية العربية الليبية

عثمان الكاديكي ورجب أبو عجيلة الرعيض

خلاصة: تسجّل هذه المقالة الخصائص السريرية للسكّري غير المعتمد على الإنسولين المشخّص في بنغازي ومعدل انتشاره. لقد استمدت البيانات من تحليل للسجلات المتاحة عن المدة 1981 إلى 1990. وتبيّن أن عدد حالات السكّري غير المعتمد على الإنسولين المسجّلة خلال مدة الدراسة يبلغ 8922 حالة (4081 من الذكور و4841 من الإناث). وبلغ معدل الانتشار العام 0.19%، وكان أعلى بدرجة جوهرية بين الإناث (0.21%) عنه بين الذكور (0.17%) (P<0.01). وكان معدل الانتشار في المرضى الذين يبلغون من العمر عشرين سنة فأكثر 3.8% وكان أعلى بدرجة جوهرية في الإناث (4.7%) عنه بين الذكور (2.9%) (P<0.01). ولوحظ ارتفاع معدلات الانتشار مع ارتفاع الفئات العمرية، وبلغت الذروة في الفئة 54-50 سنة. وبلغ معدل انتشار ضغط الدم المرتفع 22.5% ومعدل فرط الوزن 59.4%. ووجد أن أكثر مضاعفات السكّري انتشاراً كانت الاعتلالات العصبية (45.7%) والشبكية (30.5%) والكلوية (25.2%).

ABSTRACT The clinical characteristics and prevalence of non-insulin-dependent diabetes mellitus (NIDDM) diagnosed in Benghazi are reported. Data were based on the analysis of records for the period 1981 to 1990. A total of 8922 NIDDM cases (4081 males, 4841 females) were registered during the study period. The overall prevalence rate of NIDDM was 0.19%; it was significantly higher in females (0.21%) than males (0.17%) ($P < 0.01$). The prevalence rate in patients aged ≥ 20 years was 3.8% and was significantly higher in females (4.7%) than in males (2.9%) ($P < 0.01$). Prevalence rates increased with each higher age group and peaked in the 50–54 years age group. Prevalence of hypertension was 22.5% and prevalence of overweight was 59.4%. The most common complications of diabetes were neuropathy (45.7%), retinopathy (30.5%) and nephropathy (25.2%).

Tableau épidémiologique et clinique du diabète sucré à Benghazi (Jamahiriya arabe libyenne)

RESUME Les caractéristiques cliniques et la prévalence du diabète sucré non-insulino-dépendant diagnostiqué à Benghazi sont rapportées dans cet article. Les données étaient basées sur l'analyse des dossiers pour la période allant de 1981 à 1990. Au total, 8922 cas de diabète non-insulino-dépendant (4081 hommes et 4841 femmes) ont été enregistrés durant la période étudiée. Le taux de prévalence globale du diabète non-insulino-dépendant s'élevait à 0.19%; il était considérablement plus élevé chez les femmes (0,21%) que chez les hommes (0,17%) (p<0,01). Le taux de prévalence chez les patients âgés de 20 ans et plus s'élevait à 3,8%, il était considérablement plus élevé chez les femmes (4,7%) que chez les hommes (2,9%) (p<0,01). Les taux de prévalence augmentaient à chaque groupe d'âge supérieur et atteignaient le maximum dans le groupe d'âge des 50-54 ans. La prévalence de l'hypertension s'élevait à 22,5% et celle de la surcharge pondérale à 59,4%. Les complications du diabète les plus courantes étaient les neuropathies (45,7%), les rétinopathies (30,5%) et les néphropathies (25,2%).

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Introduction

Improvement of health services in developing countries, including Arab countries, over the past three decades has resulted in the publication of a number of papers on the epidemiology of diabetes mellitus in these countries. Very few studies on the epidemiology of diabetes mellitus in the Libyan Arab Jamahiriya have been published [*1,2*]. In this paper we describe the clinical features and prevalence of non-insulin-dependent diabetes mellitus (NIDDM) cases in Benghazi.

Patients and methods

Health services in the Libyan Arab Jamahiriya are integrated and provided by the State. Health services for diabetic patients consist of a national diabetes committee (Libyan National Diabetes Committee; LNDC), diabetic centres in large cities and diabetic clinics in smaller cities [*3*]. There are no private or military hospitals in the country and up to the end of 1990 private practice was not permitted. Insulin (human) and oral hypoglycaemic agents are available only in diabetic centres, diabetic clinics and in hospitals for inpatients.

A registry of all newly diagnosed diabetic patients in the Benghazi area was opened in the Benghazi Diabetic Clinic (BDC) in 1969. BDC is a day clinic serving the Benghazi area and it includes a general diabetic clinic, a children's clinic and a pregnancy clinic. The pregnancy clinic is conducted twice weekly and is run by a team of physicians and obstetricians.

Mandatory registered data for each patient include name, age, sex, occupation, residence, family history of diabetes, presentation of diabetes, height, weight, blood pressure and obstetric history in the case of females. The criteria of diagnosis and classification of diabetes into IDDM and NIDDM are those recommended by the World Health Organization [*4*].

In our study, family history of diabetes was considered positive if a first degree relative (parent or sibling) was diabetic. Overweight was defined as a body mass index (BMI) equal to or more than 27 kg/m^2 for males and 25 kg/m^2 for females [BMI = weight (kg)/height (m^2)]. Hypertension was defined as blood pressure $\geq$ 160/95 mmHg.

The incidence data were based on the analysis of files during the period from 1 January 1981 to 31 December 1990. Incidence was calculated from the number of new cases in each age group divided by the number of population at risk in each year. The mean annual incidence rate was calculated as the total number of new cases in 10 years in each age group divided by the total number of population at risk.

Prevalence data were calculated from the total number of regular patients in each age group at the end of 1990 divided by the total population at risk. The incidence rates and prevalence rates are presented in 5-year increments with sex stratification. The number of residents per sex and 5-year age group for the years 1981 to 1990 were obtained from the National Census Bureau in Tripoli.

The long-term complications of diabetes and causes of death in diabetic patients were also studied.

An ordinary χ^2 was applied to test the significance of difference. The criterion for significance was P-value < 0.05.

Results

A total of 15 212 diabetic patients (males 6833, females 8379) were on the register at BDC at the end of 1990. Of the total clinic

population, 561 patients were cases of IDDM (3.7%) and the rest were cases of NIDDM (96.3%). The mean age (± SD) of all patients was 47.25 ± 12.93 years; it was higher in males than in females (47.90 ± 13.30 years versus 46.72 ± 12.60 years). The mean age of NIDDM patients was 48.37 ± 11.62 years and was higher in males than in females (49.27 ± 11.75 years versus 47.65 ± 11.46 years).

Family history of diabetes was positive in 28.2% of patients with NIDDM, and 59% of patients with NIDDM were obese (males 42.5%, females 74.9%) (Table 1). The prevalence of hypertension among patients with NIDDM was 22.5% (females 26.1%, males 18.5%) (Table 2). The majority of NIDDM patients (84.5%) were referred by polyclinics with the classical symptoms of diabetes: polyurea, polydipsia and loss of weight; while 8% were diag-

Table 1 **Prevalence of obesity among 7077 patients with NIDDM aged ≥ 20 years in Benghazi**

Age group (years)	Males			Females			Total		
	Number of patients	Obese patients		Number of patients	Obese patients		Number of patients	Obese patients	
		No.	%		No.	%		No.	%
20–39	774	327	42.2	989	782	79.1	1763	1109	62.9
40–49	960	420	43.8	1266	1007	79.5	2226	1427	64.1
50–59	927	463	49.9	857	626	73.0	1784	1089	61.0
≥ 60	715	224	31.3	589	357	60.6	1304	581	44.6
Total	3376	1434	42.5	3701	2772	74.9	7077	4206	59.4

NIDDM = non-insulin-dependent diabetes mellitus

Table 2 **Prevalence of hypertension among 8124 patients with NIDDM aged ≥ 20 years in Benghazi**

Age group (years)	Males			Females			Total		
	Number of patients	Hypertensive patients		Number of patients	Hypertensive patients		Number of patients	Hypertensive patients	
		No.	%		No.	%		No.	%
20–39	759	59	7.8	1164	128	11.0	1923	187	9.7
40–49	1228	179	14.6	1407	314	22.3	2635	493	18.7
50–59	1078	250	23.2	976	354	36.3	2054	604	29.4
≥ 60	768	221	28.8	744	326	43.8	1512	547	36.2
Total	3833	709	18.5	4291	1122	26.1	8124	1831	22.5
Control group	695	40	5.8	765	54	7.1	1460	94	6.4

NIDDM = non-insulin-dependent diabetes mellitus

Table 3 **Incidence rate (per 1000) of NIDDM in Benghazi (1981–1990)**

Age group (years)	Males		Females		Total	
	N	Incidence	*N*	Incidence	*N*	Incidence
0–4	0	0	0	0	0	0
5–9	0	0	1	0.002	1	0.001
10–14	5	0.016	7	0.023	12	0.019
15–19	13	0.05	15	0.60	28	0.055
20–24	50	0.24	56	0.28	106	0.26
25–29	115	0.73	181	1.21	296	0.96
30–34	212	1.69	442	3.77	654	2.69
35–39	397	3.99	807	8.25	1204	6.10
40–44	553	6.31	772	9.54	1325	7.86
45–49	648	9.06	707	10.76	1355	9.88
50–54	802	13.14	839	15.95	1641	14.47
55–59	467	10.01	317	7.49	784	8.95
60–64	376	10.96	425	13.04	801	11.97
65–69	200	8.33	157	6.54	357	7.44
≥ 70	243	8.74	115	6.80	358	7.75
Mean annual incidence	4081	1.71	4841	2.15	8922	1.93

NIDDM = non-insulin-dependents diabetes mellitus

nosed in hospital and 7.5% became aware of the symptoms of diabetes and came to the clinic by themselves to have their blood sugar measured.

During the period, 1981–1990, 8922 patients with NIDDM (males 4081, females 4841) were registered. The overall mean annual incidence was 0.19% (Table 3) and was significantly higher in females (0.21%) than in males (0.17%) ($P < 0.01$).

The prevalence rate of NIDDM in patients aged ≥ 20 years at the end of 1990 was 3.8% (Table 4). The rate was significantly higher in females (4.7%) than in males (2.9%) ($P < 0.01$). Incidence and prevalence rates were lowest in those < 30 years of age, increased with each higher age group and peaked in the 50–54-year-old age group.

Table 4 **Age-specific prevalence rate (per 100) of diagnosed cases of NIDDM in Benghazi (1990)**

Age group (years)	Males		Females		Total	
	N	Rate	*N*	Rate	*N*	Rate
20–24	63	0.3	59	0.2	122	0.2
25–29	100	0.5	185	1.0	285	0.8
30–34	176	1.2	296	2.6	474	2.0
35–39	216	2.7	843	7.3	1059	5.0
40–44	512	4.9	864	9.0	1376	6.9
45–49	537	6.3	836	10.7	1373	8.4
50–54	640	9.4	848	13.3	1488	11.3
55–59	408	7.6	293	5.7	701	6.7
60–64	276	6.7	429	11.0	705	8.8
65–69	118	4.1	168	5.8	286	4.9
≥ 70	124	3.6	141	4.0	265	3.8
Mean	3172	2.9	4962	4.8	8134	3.8

NIDDM = non-insulin-dependent diabetes mellitus

Table 5 **Complications of diabetes in 960 patients with NIDDM**

Complication	No.	%
Peripheral neuropathy	439	45.7
Retinopathy	293	30.5
Nephropathy	242	25.2
Triopathy	83	8.6
Ischaemic heart disease	126	13.1
Peripheral vascular disease	105	10.9
Diabetic foot	17	1.8

NIDDM = non-insulin-dependent diabetes mellitus

Table 6 **Causes of death among diabetic patients aged ≥ 20 years in Benghazi (1994)**

Cause of death	M	F	Total
Myocardial infarction	24	23	47
Cerebrovascular disease	13	14	27
Chronic renal failure	13	11	24
Hypoglycaemia	6	6	12
Septic shock	5	7	12
Infection	7	5	12
Cancer	4	7	11
Diabetic ketoacidosis	6	4	10
Pneumonia	4	3	7
Not specified	35	37	72
Total	116	118	234

M = males F = females

The long-term complications of diabetes in 960 patients (416 males, 544 females) are shown in Table 5. The causes of death in diabetic patients during the period 1 January 1994–31 December 1994 are shown in Table 6.

Discussion

It was difficult to assign some patients as having IDDM or NIDDM. Patients who were initially controlled by diet but after a few years became classical ketosis-prone insulin-dependent patients, and patients who presented with diabetic ketoacidosis and subsequently were controlled by oral hypoglycaemic agents were classified as NIDDM cases.

Malnutrition-related diabetes, which has been described in many African and Asian countries has not been observed in Benghazi and has not been reported in Arab countries.

The mean age at onset and peak age of diagnosis in the sixth decade in our population are similar to other studies [*5*]. The female predominance found in Benghazi is similar to Egypt, Sudan and Qatar [*6–8*], whereas male predominance has been reported in Ethiopia, Tunisia, United Arab Emirates and Yemen [*9–12*]. This difference in sex ratio may be due to the fact that in some developing countries both sexes may not have equal access to diabetic care services. Family history of diabetes was positive in 28.2% of NIDDM cases, which is lower than the figures quoted for Sudan (67%) [*7*], the United Kingdom (41%) [*13*] and Qatar (33%) [*8*], and higher than the figures quoted for Yemen (15%) [*12*], Ethiopia (7.6%) [*9*] and Nigeria (2.4%) [*5*].

The second WHO Expert Committee on Diabetes Mellitus [*4*] concluded that obesity was the most powerful risk factor for NIDDM: 60% of NIDDM patients in Benghazi were obese. This is comparable to industrialized countries and higher than in developing countries [*5,9,12*], which may reflect variations in socioeconomic development in the different countries.

Diabetes and hypertension are well known risk factors for cardiovascular dis-

case. Hypertension is estimated to be twice as common in the diabetic population compared with non-diabetics. In Benghazi, the prevalence of hypertension in diabetic patients (22.5%) was more than 3-fold higher than in the normal control group (6.4%).

The prevalence of diagnosed diabetes in Benghazi in 1990 was 3.8% among ≥ 20-year-olds. This rate is between 4.3% in Sweden [*14*] and 1.6% in the United States of America [*15*]. In contrast to affluent societies [*13*], the prevalence in our study was higher in females.

Estimates of diabetes prevalence from registries underestimate the true prevalence. There are at least one or more undiagnosed cases for each known case. In Tanzania there were eight unknown cases for every known case of diabetes.

King and Rewers reported the prevalence of diabetes and impaired glucose tolerance (IGT) in the 30–64 years age group in 32 countries [*16*]. Diabetes was absent or rare (< 3%) in some developing countries, 3%–10% in European countries, 14%–20% in Arabs, migrant Asians, Indians, Chinese and Hispanic Americans, 41% in Nauruans and 50% in Pima Indians.

The WHO Expert Committee [*4*] has recommended that the whole or plasma glucose value 2 hours after a 75 g oral glucose load be used to determine the prevalence of diabetes and IGT in a population. Results should be age standardized for comparison with international studies. A prevalence survey in the Benghazi area based on WHO criteria has just been completed. However, a preliminary survey in Benghazi using a stratified sample, fasting plasma glucose and WHO criteria, which included 1961 subjects, showed a prevalence of 11.3% for those aged ≥ 20 years (unpublished data).

It is difficult to ascertain the incidence of diabetes in a population. Serial systematic studies using WHO criteria should be performed on a fixed population to estimate a valid "true" NIDDM incidence. Such studies have been carried out on the Pima Indians of Arizona, Micronesians and the Maltese. The Pima Indians have an NIDDM incidence rate of 1.85% at all ages [*17*]. For Micronesians the incidence rate is 1.54% [*18*] and in Malta it is 0.71% [*19*]. In the United States of America, Bender et al. [*20*] reported an NIDDM incidence rate of 0.117% for three communities in Minnesota, based on physician-diagnosed diabetes. In Europe, the age-standardized mean annual incidence of diabetes was 0.331% in Laxa municipality in Sweden [*14*].

In Benghazi a few asymptomatic NIDDM cases may not register in the diabetic clinic. Another source of bias is that a few patients from outside Benghazi may register at the Benghazi diabetic clinic. For these reasons we have not commented on yearly fluctuations and seasonal variations of incidence. The incidence rate in the current study (0.19%) falls between the lower rate reported in the United States of America and the higher rates reported in Malta and Sweden. It is substantially lower than the incidence rates of Pima Indians and Micronesians. The incidence rate in the current study increased with age, peaked in the 50–54 years age group and declined thereafter. In affluent societies the incidence of diabetes rises with age and peaks in 70–79 years age group.

Data on acute complications were not available as most of these cases are treated in hospitals. As elsewhere, the frequency of complications is related mainly to the duration of diabetes and metabolic control. Most of our patients are poorly controlled. Lack of medicine is the main cause of poor control in developing countries. However, this does not apply in the Libyan Arab Jamahiriya where diabetic patients

throughout the country are provided with oral hypoglycaemic agents, insulin and disposable syringes free of charge.

The most common complications of diabetes were neuropathy (45.7%), retinopathy (30.5%) and nephropathy (25.2%). The leading causes of death of diabetic patients were myocardial infarction, cerebrovascular disease and chronic renal failure.

Conclusion

It is evident that after the control of endemic diseases in the Libyan Arab Jamahiriya (tuberculosis, schistosomiasis, malaria, trachoma and leprosy), diabetes mellitus is emerging as a major health problem. Diabetes mellitus is considered a priority in health planning in the country. A national committee for diabetes mellitus has existed since 1984. Diabetic patients all over the country are registered and treated in diabetic centres and diabetic clinics. Diagnosis and classification of diabetes mellitus are based on WHO criteria. Diagnostic facilities, human insulin and insulin syringes are free of charge. Epidemiological research is encouraged by the Secretariat of Health, medical schools and the Libyan Medical Research Council.

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Between 1995 and 2025 the number of the adult population affected by diabetes mellitus in developing countries is projected to grow by 170%, from 84 to 228 million people. By 2025, these countries will be home to 76% of all persons with diabetes, as compared with 62% in 1995. In the same period, the developed world will see a 41% increase, from 51 to 72 million people.

Worldwide, a 122% rise is projected, from a total of 135 to 300 million. This more than twofold global increase will occur because of population ageing and growth, as well as from obesity, unhealthy diets and a sedentary lifestyle. These latter factors are closely associated with urbanization and industrialization.

Source: WHO Press release WHO/63, 14 September 1998.